Measurement of Body Mass Index (BMI) using PIC 18F452 Microcontroller

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Abstract— The aim of the project was to design a microcontroller based automated Body Mass Index (BMI)calculator with LCD display, which calculates the body mass index using the two basic parameters that are weight and height. The hardware of the project consists of a weighing mechanism i.e. weighing machine, which is used to calculate the body weight of a person, and a height sensing mechanism i.e. LDR, which is use to calculate the height of a person. The weight of the person is calculated in Kilograms and the height in meters in accordance of the BMI standard formula [3]. The microcontroller based automated Body Mass Index calculator is a useful device when it comes to controlling your weight and maintaining a healthy life style. The calculated weight of the person through weighing machine, converts the mechanical force into electrical signals that can be easily obtain after processing through microcontroller. While the height of the person is calculated by the LDR , when dark light falls on it the resistance value decreases and we get high voltage at output. All this data is manipulated through microcontroller and then the result is displayed on the LCD display and a message is sent through GSM module to the person about his BMI and the suggestions related to it.

Keywords- *Body mass index; weighing machine; LDR*

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I. INTRODUCTION

Body Mass Index (BMI) is a person's weight in kilograms divided by the square of their height in meters. It is one of the most commonly used ways of estimating whether a person is overweight and hence more likely to experience health problems than someone with a healthy weight. It is also used to measure population prevalence of overweight and obesity. It is used because, for most people, it correlates reasonably well with their level of body fat. It is also a relatively easy, cheap and non-invasive method for establishing weight status. However, BMI is only a proxy for body fatness. Other factors such as fitness, ethnic origin and puberty can alter the relation between BMI and body fatness and must be taken into consideration. Other measurements such as waist circumference and skin thickness can be collected to indicate a person's weight status or body fatness. None of these is as widely used as BMI.[10]

Table 1.1-Reference table for BMI measurement

Classification	BMI(kg/m^2)	
	Principal cut-off points	**Additional cut-off points**
Underweight	**<18.50**	**<18.50**
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	**18.50 - 24.99**	18.50 - 22.99
		23.00 - 24.99
Overweight	**≥25.00**	**≥25.00**
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
Obese	**≥30.00**	**≥30.00**
Obese class I	30.00 - 34.99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

II. LITERATURE SURVEY

1. HEIGHT,WEIGHT AND BODY MASS INDEX MEASUREMENT USING MATLAB by Mr. Shrikant J. Honade.The proposed method in this paper is webcam is used to capture the image of person, whose height is to be measured. To capture the image by using webcam image acquisition toolbox is used. After capturing the image of candidate, the processing is done on the image by using efficient digital image processing tool that comes with MATLAB. Also, weight sensor is used for measuring the weight of the person and hence by using height and weight, Body Mass Index (BMI) is calculated to decide the fitness of person.The drawback of the paper is that the mechanism used for weight measurement needs special circuitry having microcontroller,Op-Amp,ADC which can be done using PIC in cost effective way.   In this way microcontroller from the AVR family was applied for sampling of analog signal and also monitoring weight. Finally with using of Probabilistic Neural Network fault detection at zero level was carried out hence, safety of system was increased.

2. LOAD CELL DESIGN AND CONSTRUCT WITH FAULT DETECTION BY PROBABILISTIC NEURAL NETWORK by Moradkhani, A. In this study of a strain gage load cell as a S model has been designed which is used for measuring weight. Four methods of fixing and balancing Whetstone Bridge were considered and one way was achieved eventually which was given the best Whetstone Bridge's output. For amplifying and measuring of changing resistance and voltage in Whetstone Bridge four current ways of amplifying and measuring were applied and with doing some modification in one of them construction of the main model was made. In this way microcontroller from the AVR family was applied for sampling of analog signal and also monitoring

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weight. Finally with using of Probabilistic Neural Network fault detection at zero level was carried out hence, safety of system was increased.

III. BMI CONCEPT

A. Usage

BMI is only an approximation for determining potential weight problems but it cannot be used as a diagnostic tool. A person will be on a great risk if they have a high BMI. Through these measurements physician can recommend different health risk related to weight. For example Skin fold measurements, fitness of a person, nutritionist can decide the diet of a person, and other screening of person's health.

B. Formula

The calculation of BMI can be calculated with the help of given standard formula.

BMI = [(Weight in Kilograms / (Height in Meters x Height in Meters)] [3]

C. Health Consequences of Overweight and Obesity

Overweight and obese individuals are at increased risk for many diseases and health conditions, including the, high blood pressure, high LDL cholesterol and low HDL cholesterol, diabetes, plaque in arteries of heart, heart Stroke, gallbladder infection, degenerative joint disease, respiratory problems, and breast cancer [4].

IV. BLOCK DIAGRAM

A. Project Design

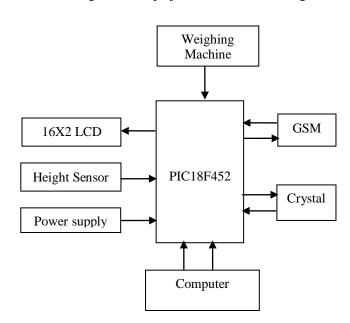The block diagram of the project is as shown in the figure

Figure. 1. Block Diagram of BMI Circuit

B. Elements of block diagram

The project consists of following blocks, as shown in the block diagram.
1. PIC18F452

2. Height sensor(LDR)
3. GSM Module
4. DC Power Supply
5. Weighing Machine
6. LCD

C. Features

1. PIC18F452
- Linear program memory addressing to 32 Kbytes.
- High current sink/source 25mA/25mA.
- Parallel slave port(PSP) module.
- Power saving sleep mode.
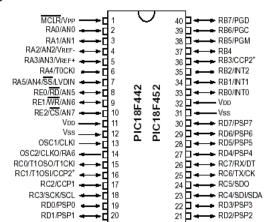- Wide operating voltage range(2.0V to 5.5V).

Figure.2 PIN diagram of PIC 18F452

2. LDR
- Resistance - 400 ohm to 400K ohm.
- Normal resistance variation: 1Kohm to 10Kohm
- Sensitivity: about 3msec
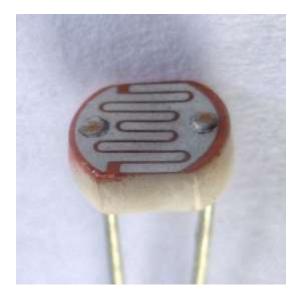- Voltage ratings: I used it on 3V,5V and 12V

Figure.3 LDR

3.GSM Module
- Simple DB9 RS232 interface
- No voice function
- Input voltage : 9V - 12V DC / 1A
- Operating Voltage – 3.6V
- Can Send and receive data and SMS
- Inbuilt antenna with high sensitivity
- Size: 122 mm * 57 mm

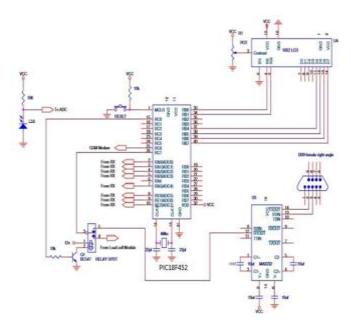Figure.4 GSM Module

D. Construction of the Project

Figure.5 Circuit Diagram of BMI

V. WORKING

The information of person whose BMI is to be calculated will be taken at first.. The height of the person will be sensed by LDR sensor. If height is not sensed the system will start again. After height weight will be sensed on weighing machine. The

both height and weight information will be stored in computer and will also be displayed on LCD.The calculation for BMI will be performed by the microcontroller. The result will be displayed on LCD and similar message will be forwarded to the person.

If height or weight is not sensed then the step will be repeated for proper sensing of height and weight. The GSM 300 used is interfaced for communication purpose. The respective person's number will be taken and information about its BMI will be sent. The precautions which need to be taken by person will be sent by GSM. The same information will be stored in the computer for data purpose.

VI. ADVANTAGES

- BMI is the most convenient and most efficient measure of obesity. Our particular project aims to provide a further convenient way to measure BMI as it removes the hassle of calculations.
- It can be used in rural areas for surveys.

VII. APPLICATIONS

- The automatic Body mass index calculator has many applications in the vast field of biomedical engineering.
- As we all know that the biomedical engineering is about the application of engineering in the field of medicine.
- The electronic BMI is such a device which is used in Hospitals, Clinics, and even
- Pharmacies. It can be placed at Gyms, Airports, Hotels, Bus Stands and other social places as well.
- It can also be used for commercial purposes by installing a fool proof coin acceptor system.

VIII. CONCLUSION

This project titled 'Measurement of Body Mass Index' is a statistical tool is, to calculate the Health Risk of different diseases. The theoretical study, which was done in the start of project, tells about the significance of BMI as a heath indicator.

With respect to theoretical study various papers were refereed and their approach towards calculating the body mass index and taking into account their disadvantages an efficient solution for measuring BMI is brought out.

IX. FUTURE PLAN

- The efficiency of the project can be increased by increasing number of height sensors. we can increase the number of sensors for various heights.
- The weighing limitation can be increased in future.
- By using additional module the blood pressure and other parameters can be measured.

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